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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/607,083	06/27/2003	Toru Kurosaki	030781	5416

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EXAMINER
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TRAN, TAN N

ART UNIT	PAPER NUMBER
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2826

DATE MAILED: 06/17/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/607,083

Applicant(s)

KUROSAKI ET AL.

Examiner

TAN N TRAN

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 30 April 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-12 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-9 is/are rejected.
- 7) ☒ Claim(s) 10-12 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 02/02/04.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### **Claim Objections**

1. Claims 11,12 are objected to because of the following informalities:

Claim 11 should be canceled because limitations of claim 12 are redundant from all limitations of claims 1,2,11.

In claim 12, lines 14-17, “wherein a schottky electrode forming ohmic junctions with the semiconductor fillers and a schottky junction with the low concentration layer is provided on surfaces of the semiconductor fillers provided in the active grooves and on surfaces of parts of the low concentration layer situated between the active groove, in a region surrounded by the inner circumferential groove, and” should be deleted because they are redundant lines 18-21.

### **Claim Rejections - 35 USC § 102**

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 1-4,6-8 stand rejected under 35 U.S.C. 102(a) as being anticipated by Applicant’s prior art (APA) figs. 37 and 38.

With regard to claim 1, APA discloses a semiconductor substrate 110 including a low concentration layer 112 of a first conductivity type, the semiconductor substrate 110 having grooves formed on its surface on the low concentration layer side, wherein the grooves include a plurality of narrow active grooves (122<sub>1</sub>-122<sub>4</sub>) and a ring-shaped inner circumferential groove 130 surrounding the active grooves (122<sub>1</sub>-122<sub>4</sub>), the bottom faces of the active grooves (122<sub>1</sub>-122<sub>4</sub>) and a bottom face of the inner circumferential groove 130 are provided in the low concentration layer 112, and both ends of the active grooves (122<sub>1</sub>-122<sub>4</sub>) are indirectly connected to the inner circumferential groove 130 by the low concentration layer 112. (Note figs. 37, 38 of APA).

With regard to claim 2, APA discloses a semiconductor filler 125 of a second conductivity type is provided in each of the active grooves (122<sub>1</sub>-122<sub>4</sub>) and the inner circumferential groove 130, and the semiconductor filler 125 in each of the active grooves (122<sub>1</sub>-122<sub>4</sub>) is connected to the semiconductor filler 125 in the inner circumferential groove 130. (Note figs. 37, 38 of APA).

With regard to claim 3, APA discloses the semiconductor substrate 110 has a plurality of ring-shaped guard ring grooves (123<sub>1</sub>-123<sub>3</sub>) concentrically surrounding the inner circumferential groove 130. (Note figs. 37, 38 of APA).

With regard to claim 4, APA discloses the semiconductor filler 125 is provided in each of the guard ring grooves (123<sub>1</sub>-123<sub>3</sub>). (Note figs. 37, 38 of APA).

With regard to claim 6, APA discloses the semiconductor substrate 110 including gate grooves by removing an upper portion of the semiconductor filler 125 in each of active grooves (122<sub>1</sub>-122<sub>4</sub>), remaining portions corresponding lower portions of the semiconductor fillers 125

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situated at lower portions of the gate grooves; a gate insulating film 151 provided at least on a side face of each the gate grooves; gate electrode plugs having a gate electrode 155 provided in contact with the gate insulating film 151 in the gate grooves, being insulated from the remaining portions of the semiconductor filler 125; a base region 133 of a second conductivity type provided on a surface side inside the low concentration layer 112 at a position in contact with the gate insulating film 151; and a source region 166 of a first conductivity type having a source electrode 167 provided at position on a surface side inside the base region 133 so as to be separated from the low concentration layer 112 and to be in contact with the gate insulating film 151, wherein when a voltage is applied to the gate electrode plugs 155 to form an inversion layer of the first conductivity type in a portion of a base region 133 in contact with the gate insulating film 151, the source region 166 and the low concentration layer 112 are connected to each other through the inversion layer. (Note lines 22-26, page 4, and lines 1,2, page 5 of applicant's specification; and figs. 37, 38 of APA).

With regard to claim 7, APA discloses all the claimed subject matter except for a height of the semiconductor filler 125 provided in the inner circumferential groove 130 is higher than that of the remaining portions of the semiconductor fillers 125 in the active grooves (122<sub>1</sub>-122<sub>4</sub>). (Note fig. 39 of APA).

With regard to claim 8, APA discloses the semiconductor substrate 110 includes a N type semiconductor layer 111 serves as drain layer wherein a drain electrode 170 forming an ohmic junction with the drain layer 111 is provided on the drain layer 111. (Note figs. 37, 38 of APA).

***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 5,9 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's prior art (APA) figs. 37 and 38.

With regard to claim 5, APA discloses the inner circumferential groove 130 is formed in a quadrangular ring shape, each of the active grooves (122<sub>1</sub>-122<sub>4</sub>) is provided in a parallel direction to two parallel sides among four sides of the inner circumferential groove 130. (Note figs. 37, 38 of APA). APA figs. 37 and 38 disclose all the claimed subject matter except for the low concentration layer has a surface of a plane orientation 100 wherein the 100 plane of crystal of the semiconductor substrate is exposed on a side face and a bottom face inside each of the active grooves and on a side and a bottom face inside the inner circumferential groove. However, it would have been obvious to one of ordinary skill in the art to form the low concentration layer has a surface of a plane orientation 100 wherein the 100 plane of crystal of the semiconductor substrate is exposed on a side face and a bottom face inside each of the active grooves and on a side and a bottom face inside the inner circumferential groove, because such structure is conventional in the art for forming a plurality of the active grooves in the low concentration substrate layer.

With regard to claim 9, APA discloses all the claimed subject matter except for the semiconductor substrate includes a collector layer of the second conductivity type, forming a PN

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junction with the low concentration layer, and a collector electrode film forming an ohmic junction with the collector layer is formed on the collector layer. However, it would have been obvious to one of ordinary skill in the art to form the semiconductor substrate includes a collector layer of the second conductivity type, forming a PN junction with the low concentration layer, and a collector electrode film forming an ohmic junction with the collector layer is formed on the collector layer because that structure is conventional in the art for forming an insulated gate bipolar transistor. Note (fig. 1 of Kawahashi et al. (6,509,610)) is cited to support for the well know position.

***Allowable Subject Matter***

4. Claim 12 is allowable over the prior art of record, because none of these references disclose or can be combined to yield the claimed invention such as a schottky electrode forming ohmic junctions with the semiconductor fillers and a schottky junction with the low concentration layer is provided on surfaces of the semiconductor fillers provided in the active grooves and on surfaces of parts of the low concentration layer situated between the active groove, in a region surrounded by the inner circumferential groove.

5. Claim 10 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim 10 is allowable over the prior art of record, because none of these references disclose or can be combined to yield the claimed invention such as a schottky electrode film forming a schottky junction with the low concentration layer is provided on a surface of the low concentration layer.

#### **Response to Arguments**

6. Applicant's arguments filed 04/30/04 have been fully considered but they are not persuasive.

It is argued, at page 15 of the remarks, that "in applicants' specification, in order to avoid the partitioning by a low concentration layer 12 of both ends of the active grooves 22 and the inner circumferential groove 30, such active grooves 22 and the inner circumferential groove 30 are connected. Such structural arrangement is clearly illustrate in, e.g., the applicants' Figures 1 and 4. Moreover, the above-noted structural arrangement is specifically recited independent claim 1. Such distinguishable structural arrangement as set forth in claim 1, is not disclosed in the APA"; and "Since not all of the claimed elements or features, as recited in claim 1, are found in exactly the same situation and united in the same way to perform the identical function in the APA, there can be no anticipation of the applicant's claimed invention under 35 U.S.C 102 (a) based on the APA". However, figs. 37, 38 of APA do show both ends of the active grooves (122<sub>1</sub>-122<sub>4</sub>) are indirectly connected to the inner circumferential groove 130 through the low



concentration layer 112. Since claim 1 does not recite both ends of the active grooves are directly connected to the inner circumferential groove, applicant's claim 1 does not distinguish over APA reference.

### **Conclusion**

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

8. Any inquiry concerning this communication or earlier communication from the examiner should be directed to Tan Tran whose telephone number is (571) 272-1923. The examiner can normally be reached on M-F 8:30AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on (571) 272-1915. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9306 for regular communications and (703) 872-9306 for after final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-3900.

TT

June 2004

  
**Minhloan Tran**  
**Primary Examiner**  
**Art Unit 2826**